Inefficient equilibria and lockouts in wage bargaining with discount rates varying in time

Ahmet Ozkardas, Agnieszka Rusinowska

– PANTHÉON - SORBONNE –
UNIVERSITÉ PARIS 1

Documents de Travail du
Centre d'Economie de la Sorbonne

CES Working Papers

Inefficient equilibria and lockouts in wage bargaining with discount rates varying in time

Ahmet OZKARDAS, Agnieszka RUSINOWSKA

2014.73

Maison des Sciences Économiques, 106-112 boulevard de L'Hôpital, 75647 Paris Cedex 13
http://centredeconomiesorbonne.univ-paris1.fr/
ISSN : 1955-611X

Inefficient equilibria and lockouts in wage bargaining with discount rates varying in time

Ahmet Ozkardas[2,3] and Agnieszka Rusinowska[1]

[1] Paris School of Economics - CNRS
Université Paris I Panthéon-Sorbonne, Centre d'Economie de la Sorbonne
106-112 Bd de l'Hôpital, 75647 Paris, France
Phone: 0033 144 078 212, Fax: 0033 144 078 301
agnieszka.rusinowska@univ-paris1.fr
[2] Turgut Ozal University
Faculty of Economics and Administrative Sciences, Department of Economics
Ayvali Mh. 158. Cd. Etlik Kecioren/Ankara, Turkey
aozkardas@turgutozal.edu.tr
[3] Université Paris I Panthéon-Sorbonne, Paris, France

Abstract. We consider a union-firm wage bargaining in which the preferences of the union and the firm are expressed by sequences of discount rates varying in time. The contribution of the paper is twofold. First, we consider a model in which the union must choose between strike and holdout in case of disagreement. We show that there exist inefficient subgame perfect equilibria in the model where the union engages in several periods of strikes prior to reaching a final agreement. Furthermore, we analyze a wage bargaining in which the firm is allowed to engage in lockouts. We consider a game in which only lockouts are feasible, i.e., strikes are not allowed. We prove that under certain assumptions there is a subgame perfect equilibrium for this game and it leads to an immediate agreement which yields the union a wage contract smaller than the status quo contract. Under this equilibrium the firm always locks out the union after its own offer is rejected and holds out after rejecting an offer of the union.

JEL Classification: J52, C78

Keywords: union - firm bargaining, varying discount rates, subgame perfect equilibrium, inefficient equilibria, strike, lockouts

Corresponding author: Agnieszka Rusinowska

1 Introduction

In the union-firm wage bargaining originally introduced in Fernandez and Glazer (1991), Haller and Holden (1990) and further analyzed, e.g., in Holden (1994), Bolt (1995), Houba and Wen (2008), the union and the firm bargain sequentially over a new wage contract and in case of disagreement the union must choose between strike and holdout. While in this literature the parties are assumed to have constant discount rates, in Ozkardas and Rusinowska (2014a,b) we consider a generalized wage bargaining in which the preferences of both parties are expressed by sequences of discount rates varying in time. However, only efficient equilibria have been considered in this generalized framework so far. More precisely, in Ozkardas and Rusinowska (2014a) we determine subgame perfect equilibria for several cases when the strike decision of the union is exogenous and also consider the general model with no assumption on the commitment to strike. In Ozkardas and Rusinowska (2014b) the analysis of the generalized wage bargaining is continued: we derive the exact bounds of the equilibrium payoffs and characterize the equilibrium strategy profiles that support these extreme payoffs.

Apart from the analysis of efficient equilibria in the wage bargaining with constant discount rates, Fernandez and Glazer (1991) also present a result on inefficient equilibria and additionally mention an extension of the model in which the firm is allowed to lock out the union. To the best of our knowledge these issues have not been considered so far for the model with discount rates varying in time.

The aim of the present paper is to study inefficient equilibria and lockouts in the generalized wage bargaining. More precisely, the contribution of the paper is twofold. Our first result concerns a model in which the union must choose between strike and holdout in case of disagreement. We show that there exist inefficient subgame perfect equilibria in the model where the union strikes for uninterrupted T periods prior to reaching a final agreement. Next, we consider a model in which the firm is allowed to engage in lockouts. We examine a game in which only lockouts by the firm are feasible, i.e., the union is not allowed to strike. We prove that under certain assumptions there is a subgame perfect equilibrium with an immediate agreement which yields the union a wage contract smaller than the status quo contract. Under this equilibrium the firm always locks out the union after its own offer is rejected and holds out after rejecting an offer of the union.

In the remainder of the paper we proceed as follows. In Section 2, first we briefly describe the wage bargaining between the union and the firm with preferences expressed by discount rates varying in time, in which the union must choose between strike and holdout in case of disagreement. Next we prove the result on inefficient equilibria in the model. Section 3 concerns the generalized wage bargaining in which the firm is allowed to engage in lockouts. Some concluding remarks are presented in Section 4.

2 Inefficient equilibria in the generalized model with strikes

We consider the following wage bargaining procedure between the union and the firm, originally introduced in Fernandez and Glazer (1991) and Haller and Holden (1990). There is a status quo contract $w_0 \in (0, 1]$ that specifies the wage that a worker is entitled to per day of work. This wage contract needs to be renegotiated by the union and the firm who bargain sequentially in discrete time and a potentially infinite horizon. The union proposes a certain contract $W^0 \in [0, 1]$ in period 0 and if the firm accepts it, then the agreement is reached and the payoffs are $(W^0, 1 - W^0)$, i.e., the union gets W_0 and the firm $(1 - W_0)$. If the firm rejects the offer, then the union can either go on strike and then both parties obtain $(0, 0)$ in the current period or hold out which gives the payoffs $(w_0, 1 - w_0)$. Independently of the strike-holdout decision of the union, after rejecting the offer it is the firm's turn to make a new offer Z^1 in period 1, etc. This alternating-offers procedure continues until an agreement is reached. If an offer is rejected by a party, then the union decides whether or not to strike in that period and the rejecting party makes its offer in the next period. The *result* of the wage bargaining is either a pair (W, T), where W is the wage contract agreed upon and $T \in \mathbb{N}$ is the number of proposals rejected in the bargaining, or a *disagreement* denoted by $(0, \infty)$ and meaning the situation in which the parties never reach an agreement.

Fernandez and Glazer (1991) analyze the model in which preferences of the union and the firm are expressed by constant discount rates δ_u and δ_f, respectively, and Haller and

Holden (1990) even assume that both parties have the same discount rate δ. Contrary to this literature and similarly to our previous work (Ozkardas and Rusinowska, 2014a,b), we analyze the wage bargaining in which preferences of the union and the firm are described by sequences $(\delta_{u,t})_{t\in\mathbb{N}}$ and $(\delta_{f,t})_{t\in\mathbb{N}}$ of discount factors (rates) varying in time, where $\delta_{u,t}$ is the discount factor of the union and $\delta_{f,t}$ is that of the firm in period $t \in \mathbb{N}$, and $\delta_{u,0} = \delta_{f,0} = 1$, $0 < \delta_{i,t} < 1$ for $t \geq 1$. Let for each $t \in \mathbb{N}$

$$\delta_u(t) := \prod_{k=0}^{t} \delta_{u,k}, \quad \delta_f(t) := \prod_{k=0}^{t} \delta_{f,k} \tag{1}$$

and for $0 < t' \leq t$

$$\delta_u(t',t) := \frac{\delta_u(t)}{\delta_u(t'-1)} = \prod_{k=t'}^{t} \delta_{u,k}, \quad \delta_f(t',t) := \frac{\delta_f(t)}{\delta_f(t'-1)} = \prod_{k=t'}^{t} \delta_{f,k} \tag{2}$$

The utility of the result (W, T) for the union is equal to

$$U(W,T) = \sum_{t=0}^{\infty} \delta_u(t) u_t \tag{3}$$

where $u_t = W$ for each $t \geq T$, and if $T > 0$ then for each $0 \leq t < T$

$u_t = 0$ if there is a strike in period $t \in \mathbb{N}$
$u_t = w_0$ if there is no strike in period t.

The utility of the result (W, T) for the firm is equal to

$$V(W,T) = \sum_{t=0}^{\infty} \delta_f(t) v_t \tag{4}$$

where $v_t = 1 - W$ for each $t \geq T$, and if $T > 0$ then for each $0 \leq t < T$

$v_t = 0$ if there is a strike in period t
$v_t = 1 - w_0$ if there is no strike in period t.

The utility of the disagreement is equal to

$$U(0,\infty) = V(0,\infty) = 0 \tag{5}$$

We assume that the infinite series in (3) and (4) are convergent.

By $\varDelta_u(t)$ and $\varDelta_f(t)$ we denote the *generalized discount factors* of the union and the firm in period t, respectively. They are defined as follow, for every $t \in \mathbb{N}_+$:

$$\varDelta_u(t) := \frac{\sum_{k=t}^{\infty} \delta_u(t,k)}{1 + \sum_{k=t}^{\infty} \delta_u(t,k)}, \quad \varDelta_f(t) := \frac{\sum_{k=t}^{\infty} \delta_f(t,k)}{1 + \sum_{k=t}^{\infty} \delta_f(t,k)} \tag{6}$$

The generalized discount factors take into account the sequences of discount rates varying in time and the fact that the utilities are defined by the discounted streams of payoffs.

Note that for the special case of constant discount rates, i.e., if $\delta_{u,t} = \delta_u$ and $\delta_{f,t} = \delta_f$ for every $t \in \mathbb{N}_+$, $\Delta_u(t) = \delta_u$ and $\Delta_f(t) = \delta_f$.

In Ozkardas and Rusinowska (2014a,b) we consider only efficient equilibria in the generalized wage bargaining where the agreement is reached immediately in period 0. Now we will prove the result concerning inefficient subgame perfect equilibria in this model where the union strikes for uninterrupted T periods prior to reaching a final agreement.

Theorem 1 *Consider the generalized wage bargaining model with preferences of the union and the firm described by the sequences of discount factors $(\delta_{i,t})_{t\in N}$, where $\delta_{i,0} = 1$, $0 < \delta_{i,t} < 1$ for $t \geq 1$, $i = u, f$. If $\hat{w} \in [0, 1]$ and $T \geq 1$ are such that*

$$w_0 \leq \hat{w} \frac{\sum_{k=T}^{\infty} \delta_u(1,k)}{1 + \sum_{k=1}^{\infty} \delta_u(1,k)} \tag{7}$$

and for each $\tau \in \mathbb{N}$ such that $2\tau + 1 < T$

$$(1 - \hat{w}) \sum_{k=T}^{\infty} \delta_f(1,k) \geq \left(1 - \overline{Z}^{2\tau+1}\right) \sum_{k=2\tau+1}^{\infty} \delta_f(1,k) \tag{8}$$

where $\overline{Z}^{2\tau+1}$ denotes the firm's offer in period $2\tau + 1$ given by:

$$\overline{Z}^{2\tau+1} = \overline{W}^{2\tau+2} \Delta_u(2\tau + 2) \tag{9}$$

$$\overline{W}^{2\tau} = 1 - \Delta_f(2\tau + 1) + \sum_{m=\tau}^{\infty} (1 - \Delta_f(2m + 3)) \prod_{j=\tau}^{m} \Delta_u(2j + 2)\Delta_f(2j + 1) \tag{10}$$

then there is a subgame perfect equilibrium with a strike of T periods (from period 0 till $T - 1$) followed by an agreement $\hat{w}$ reached in period T.

Proof: Let $\hat{w}$ and T be such that (7) and (8) are satisfied. Let $\overline{W}^{2t}$ and $\overline{Z}^{2t+1}$ denote the offers of the union and the firm, respectively, defined in formulas (10) and (9). In Ozkardas and Rusinowska (2014a) it is proven that these are the SPE offers under the always-strike decision. Consider the following pair of strategies:
<u>Strategy of the union:</u>

(i) In every period $t < T$, where neither the union nor the firm has deviated before:
   - if t is even then make an unacceptable offer (that the firm rejects, e.g., 1 for the union)
   - if t is odd then accept y if and only if $y \geq \overline{Z}^t$
   - strike if there is a disagreement

(ii) In period T, where neither the union nor the firm has deviated before:
   - if T is even then propose $\hat{w}$
   - if T is odd then accept y if and only if $y \geq \hat{w}$
   - strike if there is a disagreement

(iii) In every period $t > T$, where neither the union nor the firm has deviated before:
   - if t is even then propose $\overline{W}^t$
   - if t is odd then accept y if and only if $y \geq \overline{Z}^t$

- strike if there is a disagreement

(iv) If in period $t \leq T$ the union deviates, then play the minimum wage strategy thereafter

(v) If in period $t \leq T$ the firm deviates, then play the always strike strategy thereafter

(vi) If in period $t > T$ any party deviates, then play the minimum wage strategy thereafter.

Strategy of the firm:

(i) In every period $t < T$, where neither the union nor the firm has deviated before:
- if t is odd then make an unacceptable offer (that the union rejects, e.g., w_0 for the union)
- if t is even then accept x if and only if $x \leq w_0$

(ii) In period T, where neither the union nor the firm has deviated before:
- if T is odd then propose $\hat{w}$
- if T is even then accept x if and only if $x \leq \hat{w}$

(iii) In every period $t > T$, where neither the union nor the firm has deviated before:
- if t is odd then propose $\overline{Z}^t$
- if t is even then accept x if and only if $x \leq \overline{W}^t$

(iv) If in period $t \leq T$ the union deviates, then play the minimum wage strategy thereafter

(v) If in period $t \leq T$ the firm deviates, then play the always strike strategy thereafter

(vi) If in period $t > T$ any party deviates, then play the minimum wage strategy thereafter.

One can show that this pair of strategies is the SPE. In every subgame such that a party has deviated before, this pair of strategies is the Nash equilibrium, since the minimum wage strategies, the always strike strategies, as well as the always strike strategies with the switch to the minimum wage strategies in case of a deviation, form the Nash equilibria; for the proofs, see Ozkardas and Rusinowska (2014a).

Also note that by virtue of (7), the union prefers to strike till period $T-1$ instead of reaching an earlier agreement. More precisely, from condition (7) the union prefers to strike till period $T-1$ instead of reaching an agreement immediately. Note that (7) implies the following condition, for every $0 < T' < T$

$$w_0 \sum_{k=T'}^{\infty} \delta_u(1,k) \leq \hat{w} \sum_{k=T}^{\infty} \delta_u(1,k) \tag{11}$$

To see that, note that

$$\hat{w} \sum_{k=T}^{\infty} \delta_u(1,k) \geq w_0 \left(1 + \sum_{k=1}^{\infty} \delta_u(1,k)\right) = w_0 \left(1 + \sum_{k=1}^{T'-1} \delta_u(1,k) + \sum_{k=T'}^{\infty} \delta_u(1,k)\right) >$$

$$> w_0 \sum_{k=T'}^{\infty} \delta_u(1,k)$$

By virtue of (11), the union prefers to strike till period $T-1$ instead of reaching an earlier agreement in period T'.

Any deviation of the union prior to period T would not be better to the union, because if the union deviates, e.g., by trying to reach an earlier agreement that the firm would prefer than $\hat{w}$ in period T, then the parties play thereafter the minimum wage strategies that give w_0 to the union.

By virtue of (8), also the firm would not be better off by deviating and trying to reach an earlier agreement, because if the firm makes an offer in any period $2\tau + 1 < T$ that the union would prefer, then the parties play the always strike strategies thereafter. ■

Fernandez and Glazer (1991) prove (Theorem 2) that in the wage bargaining[1] with constant discount rates δ_u and δ_f, if $\hat{w}$ is such that

$$\left(1 - \delta_f^{1-T}\right) F + \delta_f^{1-T} \overline{z} \geq \hat{w} \geq \delta_u^{-T} w_0 \tag{12}$$

where $\overline{w} = \frac{(1-\delta_f)F}{1-\delta_u\delta_f}$ and $\overline{z} = \frac{\delta_u(1-\delta_f)F}{1-\delta_u\delta_f}$ are the solutions to Rubinstein's original bargaining game[2] (Rubinstein, 1982), then there is a subgame perfect equilibrium with a strike of T periods followed by an agreement of $\hat{w}$. Note that if we apply our Theorem 1 to the case of constant discount rates, $\delta_{u,t} = \delta_u$ and $\delta_{f,t} = \delta_f$ for every $t \in \mathbb{N}_+$, and $F = 1$, then we recover the result of Fernandez and Glazer (1991).

3 The generalized wage bargaining with lockouts

In the generalized wage bargaining considered in Ozkardas and Rusinowska (2014a,b), only the union is allowed to engage in actions different from making offers and accepting/rejecting such as going on strike or holding out. Let us consider a model in which the firm is allowed to engage in lockouts and holdout. For simplicity and without affecting qualitatively our results, we assume that if the firm locks out the union, then the parties get $(0, 0)$, and in case of holdout – as usual – they get $(w_0, 1 - w_0)$. We examine a game in which only lockouts by the firm are feasible, i.e., the union is not allowed to strike. By $\overline{W}^{2t}_{LAR}$ and $\overline{Z}^{2t+1}_{LAR}$ we denote the SPE offers in this game. We have the following result.

Theorem 2 *Consider the generalized wage bargaining model with lockouts and without strikes, in which preferences of the union and the firm are described by the sequences of discount factors $(\delta_{i,t})_{t \in N}$, where $\delta_{i,0} = 1$, $0 < \delta_{i,t} < 1$ for $t \geq 1$, $i = u, f$. If*

$$1 - w_0 \leq \left(1 - \overline{W}^{2t+2}_{LAR}\right) \Delta_f(2t + 2) \text{ for every } t \in \mathbb{N} \tag{13}$$

and the following condition is satisfied

$$\Delta_f(2t + 1) \leq \Delta_u(2t + 1) \text{ for each } t \in \mathbb{N} \tag{14}$$

then there exists a SPE in which the agreement of $\overline{W}^{0}_{LAR}$ is reached in period 0, where for each $t \in \mathbb{N}$

$$\overline{W}^{2t}_{LAR} = w_0 \left(1 - \Delta_f(2t + 1) + \sum_{m=t}^{\infty} (1 - \Delta_f(2m + 3)) \prod_{j=t}^{m} \Delta_u(2j + 2) \Delta_f(2j + 1)\right) \tag{15}$$

$$\overline{Z}^{2t+1}_{LAR} = \overline{W}^{2t+2}_{LAR} \Delta_u(2t + 2) \tag{16}$$

This SPE is supported by the following 'generalized alternating lockout strategies':

[1] In Fernandez and Glazer (1991) the wage offers are made over discrete time periods $t \in \{1, 2, ...\}$ with the union proposing in odd-numbered periods and the firm proposing in even-numbered periods. In our setup this is also the union that starts the bargaining but in period 0, i.e., it makes its offers in even-numbered periods.

[2] Without loss of generality we assume that $F = 1$.

– *In period $2t$ the union proposes $\overline{W}^{2t}_{LAR}$, in period $2t+1$ it accepts an offer y if and only if $y \geq \overline{Z}^{2t+1}_{LAR}$.*
– *In period $2t+1$ the firm proposes $\overline{Z}^{2t+1}_{LAR}$, in period $2t$ it accepts an offer x if and only if $x \leq \overline{W}^{2t}_{LAR}$, it holds out after rejecting an offer of the union in period $2t$ and locks out after rejection of its own proposals in period $2t+1$.*
– *If, however, at some point, the firm deviates from the above rule, then both parties play thereafter according to the 'minimum-wage strategies':*
  - *The union offers w_0 for each $t \in \mathbb{N}$ and accepts y if and only if $y \geq w_0$.*
  - *The firm offers w_0 for each $t \in \mathbb{N}$ and accepts x if and only if $x \leq w_0$, and never locks out the union.*

Proof: In the proof we will write simply $\overline{W}^{2t}$ and $\overline{Z}^{2t+1}$ instead of $\overline{W}^{2t}_{LAR}$ and $\overline{Z}^{2t+1}_{LAR}$. We need to solve the following system, for each $t \in \mathbb{N}$:

$$1 - \overline{W}^{2t} = (1 - w_0)\left(1 - \Delta_f\left(2t+1\right)\right) + \left(1 - \overline{Z}^{2t+1}\right)\Delta_f\left(2t+1\right)$$

and

$$\overline{Z}^{2t+1} = \overline{W}^{2t+2}\Delta_u\left(2t+2\right)$$

which is equivalent, for each $t \in \mathbb{N}$, to

$$\overline{W}^{2t} - \overline{Z}^{2t+1}\Delta_f\left(2t+1\right) = w_0\left(1 - \Delta_f\left(2t+1\right)\right) \text{ and } \overline{Z}^{2t+1} - \overline{W}^{2t+2}\Delta_u\left(2t+2\right) = 0 \quad (17)$$

and forms a regular triangular system $AX = Y$, with $A = [a_{ij}]_{i,j\in\mathbb{N}^+}$, $X = \left[(x_i)_{i\in\mathbb{N}^+}\right]^T$, $Y = \left[(y_i)_{i\in\mathbb{N}^+}\right]^T$, where for each $t, j \geq 1$

$$a_{t,t} = 1,\ a_{t,j} = 0 \text{ for } j < t \text{ or } j > t+1 \quad (18)$$

and for each $t \in \mathbb{N}$

$$a_{2t+1,2t+2} = -\Delta_f\left(2t+1\right),\ a_{2t+2,2t+3} = -\Delta_u\left(2t+2\right) \quad (19)$$

$$x_{2t+1} = \overline{W}^{2t},\ x_{2t+2} = \overline{Z}^{2t+1},\ y_{2t+1} = w_0\left(1 - \Delta_f\left(2t+1\right)\right),\ y_{2t+2} = 0 \quad (20)$$

Since we have the same A as in the always strike decision (see Ozkardas and Rusinowska (2014a)), its (unique) inverse matrix B is the same. By applying $X = BY$ we get $\overline{W}^{2t}$ as in Theorem 2.

The 'generalized alternating lockout strategies' form a SPE. Using the similar method to the one applied in Ozkardas and Rusinowska (2014a), one can easily show that no deviation would be profitable for the deviating party.

In particular, the firm gets $(1 - w_0)\left(1 + \sum_{k=2t+2}^{\infty}\delta_f(2t+2,k)\right)$ when deviating from its lockouts decision in period $2t+1$, and $\left(1 - \overline{W}^{2t+2}\right)\sum_{k=2t+2}^{\infty}\delta_f(2t+2,k)$ when not deviating. Hence, by virtue of condition (13), the firm does not want to deviate. Also $1 - w_0 \leq \left(1 - \overline{W}^{2t+2}\right)\Delta_f(2t+2) \leq 1 - \overline{W}^{2t+2}$ and therefore we get $\overline{W}^{2t+2} \leq w_0$ and also $\overline{Z}^{2t+1} = \overline{W}^{2t+2}\Delta_u\left(2t+2\right) < w_0$. Furthermore, $\overline{W}^{2t} = \overline{Z}^{2t+1}\Delta_f\left(2t+1\right) + w_0\left(1 - \Delta_f\left(2t+1\right)\right) > \overline{Z}^{2t+1}$.

If the union deviates and offers some $x > \overline{W}^{2t}$ in period $2t$, then it gets $w_0 + \overline{Z}^{2t+1} \sum_{k=2t+1}^{\infty} \delta_u(2t+1,k)$. But from (14) and (17) we have:
$\overline{W}^{2t} = \overline{Z}^{2t+1} \Delta_f(2t+1) + w_0(1 - \Delta_f(2t+1)) = w_0 - \Delta_f(2t+1)\left(w_0 - \overline{Z}^{2t+1}\right) \geq w_0 - \Delta_u(2t+1)\left(w_0 - \overline{Z}^{2t+1}\right) = w_0(1 - \Delta_u(2t+1)) + \overline{Z}^{2t+1}\Delta_u(2t+1)$ and therefore $w_0 + \overline{Z}^{2t+1} \sum_{k=2t+1}^{\infty} \delta_u(2t+1,k) \leq \overline{W}^{2t}(1 + \sum_{k=2t+1}^{\infty} \delta_u(2t+1,k))$. Hence, the deviation would not be profitable for the union.

If the union deviates and offers some $x < \overline{W}^{2t}$ in period $2t$, then it gets $x(1 + \sum_{k=2t+1}^{\infty} \delta_u(2t+1,k)) < \overline{W}^{2t}(1 + \sum_{k=2t+1}^{\infty} \delta_u(2t+1,k))$, so the union would be worse off by this deviation.

If the union deviates in period $2t+1$ and accepts an offer that gives it less than $\overline{Z}^{2t+1}$ or rejects an offer that gives it at least $\overline{Z}^{2t+1}$, then from the second equation of (17), the union will not be better off.

If the firm deviates in period $2t+1$ when making an offer, then it gets at most $(1-w_0)\left(1 + \sum_{k=2t+2}^{\infty} \delta_f(2t+2,k)\right) < \left(1 - \overline{Z}^{2t+1}\right)\left(1 + \sum_{k=2t+2}^{\infty} \delta_f(2t+2,k)\right)$ as $\overline{Z}^{2t+1} < w_0$, so the firm would not be better off by any deviation.

If the firm deviates in period $2t$ when replying to an offer, i.e., it accepts an offer that gives it less than $1 - \overline{W}^{2t}$ or rejects an offer that gives it at least $1 - \overline{W}^{2t}$, then from the first equation of (17), the firm will not be better off. ■

Remark 1 Note that for every $t \in \mathbb{N}$, $\overline{W}_{LAR}^{2t} = w_0 \overline{W}_{AS}^{2t} < w_0$ and also $\overline{Z}_{LAR}^{2t+1} = \overline{W}_{LAR}^{2t+2} \Delta_u(2t+2) < w_0$, where $\overline{W}_{AS}^{2t}$ is the SPE offer made by the union in period $2t$ under the always strike decision. Hence, under the SPE the union gets a wage contract smaller than the status quo contract w_0. For constant discount rates, we get $\overline{W}_{LAR}^{2t} = \frac{w_0(1-\delta_f)}{1-\delta_f\delta_u}$.

4 Conclusion

There are several issues that could be examined in the follow-up research on the generalized wage bargaining. First of all, we could examine a game in which both strikes and lockouts are allowed. Our conjecture is that it is possible to generate subgame perfect equilibria in this game in which strikes alternate with lockouts before a final agreement is reached. Moreover, while in this paper we considered the model in which the firm was allowed to engage in lockouts, other extensions could also be analyzed, like the model where the union has an option of go-slow. Furthermore, it would be of importance to apply the generalized wage bargaining to model real-life situations. The first attempt is presented in Ozkardas and Rusinowska (2013), where we propose a modest application of the model with discount factors varying in time to price negotiations. We intend to continue this line of research and to investigate a more sophisticated model of pharmaceutical product price determination. In the model, a monopolistic firm that produces a patented pharmaceutical product and a health authority, i.e., government, negotiate the price of the the brand-name prescription drug.

Bibliography

W. Bolt. Striking for a bargain between two completely informed agents: Comment. *The American Economic Review*, 85:1344–1347, 1995.

R. Fernandez and J. Glazer. Striking for a bargain between two completely informed agents. *The American Economic Review*, 81:240–252, 1991.

H. Haller and S. Holden. A letter to the editor on wage bargaining. *Journal of Economic Theory*, 52:232–236, 1990.

S. Holden. Bargaining and commitment in a permanent relationship. *Games and Economic Behavior*, 7:169–176, 1994.

H. Houba and Q. Wen. On striking for a bargain between two completely informed agents. *Economic Theory*, 37:509–519, 2008.

A. Ozkardas and A. Rusinowska. An application of wage bargaining to price negotiation with discount factors varying in time. *Journal of Business Economics and Political Science*, 2(3):83–102, 2013.

A. Ozkardas and A. Rusinowska. Wage bargaining with discount rates varying in time under different strike decisions. *RAIRO-Operations Research*, 48(3):325–348, 2014a.

A. Ozkardas and A. Rusinowska. On equilibrium payoffs in wage bargaining with discount rates varying in time. *Economic Theory Bulletin*, 2014b. Forthcoming.

A. Rubinstein. Perfect equilibrium in a bargaining model. *Econometrica*, 50:97–109, 1982.